ANNUAL REPORT

MARYLAND AGRICULTURAL EXPERIMENT STATION

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THE UNIVERSITY OF MARYLAND

AGRICULTURAL EXPERIMENT STATION.

College Park – Eastern Shore

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THE UNIVERSITY OF MARYLAND
AGRICULTURAL EXPERIMENT STATION
College Park Eastern Shore

Office of the Director

In our annual report this year to you, the taxpayers of the state of Maryland, we've made a special effort to demonstrate the progress we have made in the variety, quality and timeliness of our research endeavor.

As the first part of our report shows, the University of Maryland Agricultural Experiment Station (UMAES) is taking groundbreaking strides in attacking problems faced by farmers, fruit and tree growers, and those concerned about the environment. Much of this work is taking place at the Wye Research and Education Center, under the now-1-year-old Center for Advanced Agricultural Concepts.

At the center, interdisciplinary teams of scientists are squaring off with large, real-life challenges, departing from the traditional approach of attacking small pieces of the problem – an approach that cannot afford to exist in today's environment of declining resources.

The Wye Research and Education Center is the first site in the Station's system to reorganize under the new university center concept.

This year, the second candidate in the Station's system began reorganization – the Sharpsburg Research and Education Center. We will bring you reports of progress there in a subsequent annual report.

The second part of our report illustrates the kind of rapport we have with another important group of citizens – the decisionmakers and planners in local, state and Federal governments. The university's agricultural and resource economists are in increasing demand by government leaders to provide the kinds of information they need to make sound decisions. I think you will find the diversity of research striking.

The final portion of our report this year focuses on agriculture and the environment. How does one affect the other, particularly that celebrated resource, the Chesapeake Bay? And what are scientists learning about this complex, mutually dependent relationship? Some of the answers are in this report. Some have yet to be determined.

Your continued support for agricultural research is one of the reasons we believe we have made significant accomplishments in the last year.

Your comments on what we have done and the direction we are taking are sincerely welcome.

W. Lamar Harris

W. Lamar Harris

MARYLAND AGRICULTURAL EXPERIMENT STATION

When most people think of the Wye they see pristine pastures yielding up forage to big, black, beautiful animals – the world-famous Wye Angus herd of beef cattle breeding stock.

TODAY The Wye Research and Education Center: Sowing Ideas and Soybeans With Equal Zeal

It is tucked away in splendid isolation; far enough removed from what has been described as the "madding crowd". Yet within 2 hours, scientists, government officials, local farmers and business leaders from the metropolitan area surrounding the nation's capital can converge on this fertile ground where some say the future of agriculture is planted, waiting to bloom.

The Wye Research and Education Center, set on 1,200 acres of land that is representative of virtually every Eastern Shore soil type, is an agricultural scientist's haven, where ideas and soybeans are sown with equal zeal. Rich fields of no-till corn, hybrid pine forests, peach orchards and delicate marshland meet the waters of the Wye River's tributaries, not far from the Chesapeake Bay. It is a place where, amid tradition and history, researchers are charting new territory for The University of Maryland Agricultural Experiment Station (UMAES).

In the past, the Wye and the other 10 research farms that make up the UMAES network were managed by university academic departments. An example of the farms' success is the agronomy department's pioneering work in no-tillage concepts, placing Maryland on the national map of conservation tillage innovators.

But some of agriculture's present problems cannot be solved by individual department efforts alone. More cooperative efforts across academic disciplines are needed. At the Wye, that has meant establishing a head of research and creating a new cross-disciplinary program that will manage efficiently the 100 projects now in progress under the new Center for Advanced Agricultural Concepts.

The center provides a structured environment where researchers from virtually all academic departments will work as a team, drawing on resources from the Wye, the university's five campuses and the laboratories of The University of Maryland Center for Environmental and Estuarine Studies (UMCEES). The six major research areas at the Wye are: cattle breeding and genetics; integrated pest management; plant genetics and breeding; energy development, use and conservation (including research on community services and wildlife protection); and, the interaction of land and water.

Continuing Progress With a Shift of Priorities

The research of decades ago spawned the green revolution, today's legacy of doubled crop production, and a 10-fold increase in farm labor productivity over the course of the last half-century. The emphasis on huge harvests, however, is shifting, and UMAES administrators intend to see that the Wye gets in on the research groundfloor that will produce tomorrow's legacy – one that emphasizes economic "bottom lines" and "optimum" yields, not necessarily "maximum" yields. As farmers have always known, expensive inputs such as nitrogen fertilizer, pesticides and fuel can mean not only record harvests but bankruptcy.

Just as economists are moving into the field with advice, other teams of specialists are coming together under the Wye's new Center for Advanced Agricultural Concepts. One example: the center's project on alternative energy sources for farms.

Agronomists are comparing yields of such crops as peanuts, soybeans and sunflowers for their potential to produce oil to power internal combustion engines. Agricultural engineers are developing the equipment and know-how to extract oil from the crops. Animal scientists are working on ways to convert the waste left over from the oil extraction process into feed meal for livestock. And economists are working with all three groups to answer the question "Do the returns justify the costs?"

To date, they have come up with some interesting results. For example, agricultural engineers have determined that onfarm screw presses can produce healthy amounts of high-energy oil from ground sunflower seed when moisture content is controlled. The amount of energy, in fact, is 90 percent that of standard diesel fuel. The studies continue as the engineers move from short-term tests of engines using the oil-fuel to long-term tests. Animal scientists plan to conduct feeding trials using the meal by-products, first with pigs, later with lambs. And economists are gathering the data that will help them determine total costs to produce and process seven groups of oil producing plants. They will pay special attention to those that yield a quality meal supplement for livestock.

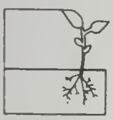
These are some other examples of the range of projects crossing over scientific disciplines:

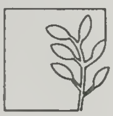
In their work to reduce the use of pesticides, entomologists look for all the "natural" weaknesses of insects – chinks in their defensive armor that will allow the scientists to make nonchemical "kills".

Integrated Pest Management (IPM), as it is called, frequently moves from the basic research laboratories of College Park and Princess Anne to the applied research environment at farm sites in the Experiment Station system. In the last year, IPM specialists tackled a number of problems facing farmers of the Eastern Shore and carried out the research in the farmers' own backyard. One important example was IPM specialists' work on the Colorado Potato Beetle, the Eastern Shore's number one insect problem when it comes to tomatoes. Their studies showed that rigid schedules of pesticide spraying can make the problem worse.

Their research also demonstrated that some plants have a remarkable ability to compensate for attacks by insects without the help – or hindrance – of insecticides. As a result, they established guidelines for local farmers called "thresholds" – those points at which it is no longer possible to rely upon a plant's natural ability to resist attack and when it is advisable to spray.

They did not stop at establishing guidelines, however. IPM specialists, working with The University of Maryland Cooperative Extension Service (UMCES) agents, helped organize a "scouting program" – putting trained professionals in the fields of farmers and growers to tell them when they have reached those thresholds. This work by IPM personnel is a classic example of university research moving from the laboratory, to the applied research plots and from there directly to Maryland farmers.

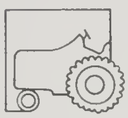




Joyce Killmer effused loving praise in his poetic tribute to "Trees". Similarly, UMAES forestry, horticulture and agronomy scientists find nothing more lovely than trees. By grafting pitch pine tops to loblolly pine roots, they are producing sturdy, vigorous hybrids that can be harvested quickly for pulpwood.

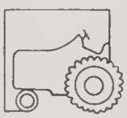
In a related project, scientists deliberately infect loblolly pines with a living substance called a "mycorrhizal fungus". The fungus and pine enjoy a mutualistic relationship, much the way animals and plants benefit from each other's oxygen and carbon dioxide in their respiration processes. The fungus helps root systems assimilate nutrients they otherwise could not, and the root systems in turn feed the fungus. The result: The pines grow two to three times faster, and scientists estimate they will be prime candidates for reforestation of strip-mined land.

A penchant for fast-growing trees, however, does not end with the ordinary pine. Scientists are capitalizing on a strange twist of fate that has placed in their laps the potential for a new export from Maryland. Some 150 years ago, Chinese traders entered the port of Baltimore with expensive goods packed in a cushion of empress tree seeds. Since then, two things have happened. The Orient lost most of its empress trees (*Paulownia tomentosa*) to urban population centers, while Maryland is sitting on a cache of valuable trees spawned by those seeds. Japanese craftsmen will forsake walnut and pay up to $1,000 for a saw log of Paulownia. The trick, scientists are discovering, is to develop an efficient method of growing straight Paulownia. Its ordinary wont is to limn the shape of a dog's hind leg. Tying into both pine and Paulownia studies are efforts by agronomists to define the uses of sludge-amended soils in establishing tree plantations.



Computer modeling saves time, money and the environment, allowing agricultural engineers to experiment with the effects of agricultural practices on the environment much the same as the animal scientist conducts *in vitro* studies before experimenting on a live animal. Researchers can apply varying amounts of nitrogen and other chemicals into the soil, and monitor their movement through the environmental system – all without spending a dime for materials or ever affecting the environment. It's all done in the computer.

Agricultural engineers also are working on a computer model that will predict solar radiation levels using existing cloud cover data – a useful tool for solar energy research. Solar energy already has made its practical debut at the Wye, powering an electric "deer fence" that humanely deters wildlife from eating research in progress.



Acid rain, typically associated with the rivers and lakes of the northeastern United States, has come to Maryland. Experiment Station scientists have recorded this year three rainfalls with a pH well below that considered "normal" for rainwater. Whether the sources are belching smokestacks in the Ohio Valley, erupting volcanoes in Mexico or the ubiquitous automobile, sulfur and nitrous oxides combine in the atmosphere with moisture and, eventually, sterilize lakes, poison crops and wildlife, and rust the cars from whence they came.

Helping scientists assess the damage is a new sophisticated weather station at the Wye, set up by the Experiment Station as part of a nationwide monitoring program on acid rain.

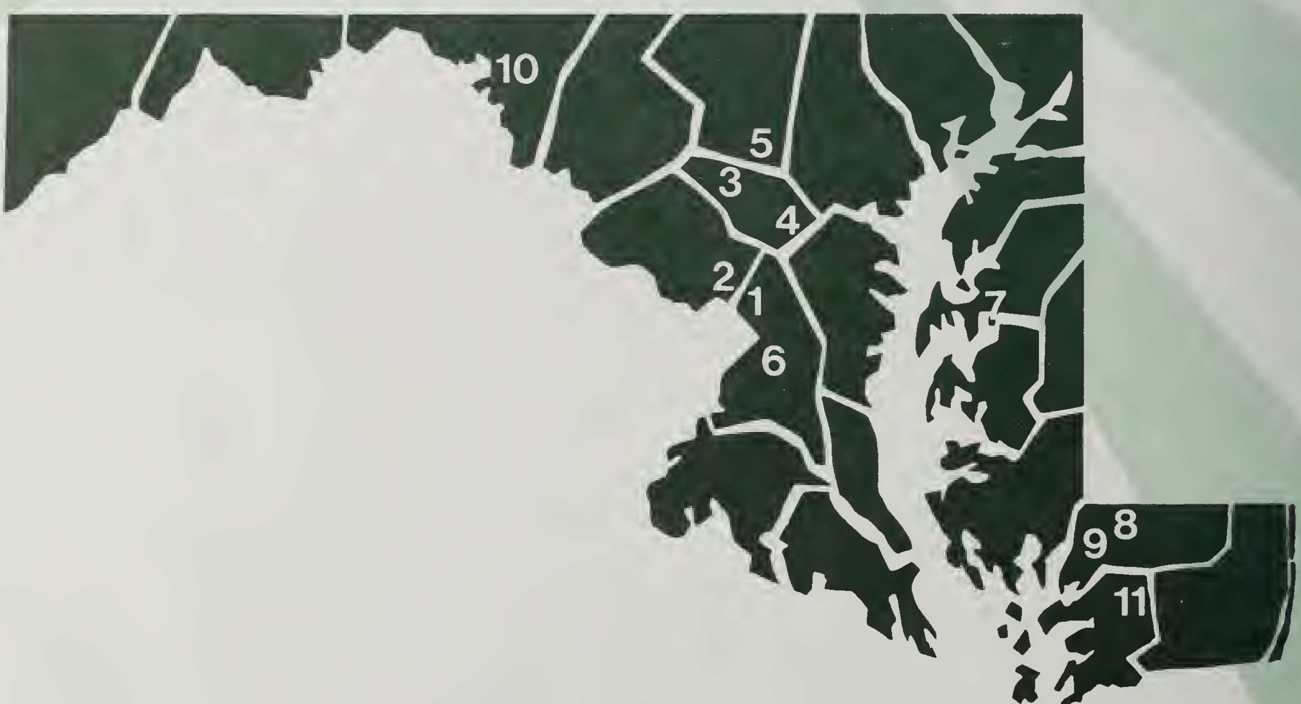
Renowned for their efficiency as food machines, the cattle of the Wye herd are more than a symbol of commercial success and genetic purity. The herd is the only repository in the world of black angus breeding stock for which meticulous records of ancestry have been kept for more than 40 years.

This data bank, the herd's genetic purity and the readily available feed resources right at the Wye make the herd part of a research program unmatched in the world. This year, a full-time, animal-genetics scientist joined the program.

Maryland's Research Farms

Gradually, the center concept as it is taking shape at the Wye will be incorporated into UMAES's other research farms. Last year, UMAES sold its 318-acre plant research farm in Montgomery county, a victim of urbanization. The revenues from that sale will go toward upgrading the other UMAES research farms.

This year, the reorganization process began as UMAES commenced looking for a head of research to manage the next candidate in the university center concept: The Sharpsburg Research and Education Center. There, a philosophy of scientific teamwork and economies of measure similar to that now at the Wye will take root to meet the special, regional needs of Western Maryland.



1 **The University of Maryland – College Park**
UMAES Headquarters (301) 454-3707
Research work in all phases of agriculture and related fields.

2 **Plant Research Farm** (Montgomery county)
Research on turfgrass, insects, truck crops and small fruit. 194 acres. (301) 572-7247 – Agronomy; (301) 572-5339 — Horticulture.

3 **Agronomy — Dairy Forage Research Farm** (Howard county)
Studies of dairy nutrition and management and pollution abatement practices. 922 acres. (301) 531-3211.

4 **Horse Research Farm** (Howard county)
Research on physiology, nutrition and management of horses. 154 acres. (301) 465-3760.

5 **Beef Research Farm** (Carroll county)
Research concerning livestock production and management. 715 acres. (301) 795-1310.

6 **Tobacco Research Farm** (Prince George's county)
Research relating to tobacco breeding, production, harvesting and curing. 206 acres. (301) 627-3273.

7 **Wye Research and Education Center** (Queen Anne's county)
Work on plant breeding, weed and disease control, and production systems for corn, soybeans, vegetables and ornamentals. 123 acres. Additional research in cooperation with Wye Institute. 355 acres. Beef cattle research with Wye Angus herd. Approximately 475 acres on Wye Plantation. (301) 827-6202 — Center Headquarters.

8 **Salisbury Research Substation** (Wicomico county)
Experimental studies dealing with poultry and breeding, insect, pest and disease control, production systems and management and processing of vegetable crops. 125 acres. (301) 742-8788 — Horticulture; (301) 543-6700 — Poultry Science.

9 **Poplar Hill Research Farm** (Wicomico county)
Studies of disease control, breeding, pest control and production systems for corn, soybeans and vegetable crops. 166 acres. (301) 742-9694.

10 **Sharpsburg Research and Education Center** (Washington county)
Research on fruits, vegetables, ornamentals, field crops, soils and disease and insect control. 546 acres. (301) 791-2298.

11 **The University of Maryland – Eastern Shore**
UMAES 1890 Agricultural Research Program
Research work in human nutrition, pest control and cultural practices for soybeans and corn, small farm development, child development. (301) 651-1598.

Diversity of Research:

The Department of Agriculture and Resource Economics Offers Policy Information at the Local, Regional, National and International Levels

A vegetable farmer on Maryland's Eastern Shore can decide with relative ease which irrigation system is going to work best in a specific situation. All the farmer has to do is consult one of several studies conducted by the university's Department of Agricultural and Resource Economics (AREC).

But what about planners in local, regional and national governments, or international policy planners? Where do they turn when they need critical information to help them form intelligent opinions? It seems they, too, are turning to the university and AREC for help.

Whether it is helping local planners decide how best to handle pollution from agricultural sources, or developing a way to measure economic benefits of a clean environment for the Federal government, AREC researchers are providing answers.

The Local Level

Comparing Waste-Handling Systems for Maryland Dairy Farms

Agricultural operations, especially those generating wastes from livestock, are coming under increasing scrutiny as possible polluters of the environment. Without research to document causes and sources, that increased attention could lead to unsubstantiated measures that would pose severe economic hardships on Maryland agriculture.

But how costly would those measures be and what alternatives are there that would satisfy both the needs of a clean environment and those of a productive agriculture?

That was the task given AREC researchers. In a 3-year study of dairy farms in the Monocacy River watershed, they found that all of the study's participants had sufficient land to dispose of livestock waste at rates that should not create severe pollution problems. Furthermore, farmers viewed pollution control as being in their own best interests. Those surveyed in the study professed a genuine interest in monitoring their own disposal of wastes and avoiding the hazards of pollution – virtually every farmer in the 970-square-mile area depended on clean, pollution-free well water.

Researchers also developed several alternative disposal methods, offering farmers a choice of methods depending upon their herd sizes, availability of capital and equipment and the unique physical characteristics of their farms.

For each alternative, policy planners and farmers can see what it actually costs in terms of labor, investment and annual operating expenses.

In general, the study shows that farmers can expect investment and net annual costs for alternative waste-handling systems to decrease per animal as herd size increases. They also can expect to invest more per animal for systems that use some form of waste storage before disposal.

AREC researchers went one step further in their analyses: They calculated how manure from different handling systems differed in terms of its fertilizer value on farmers' cropland.

The Regional Level

Assessing Maryland's Ocean Fisheries

Ocean City: It is more than a summertime mecca at the southeastern end of U.S. route 50. It also is Maryland's only offshore commercial fishing port.

In 1981, Ocean City pulled in a dockside value of $10.5 million in finfish and shellfish. Some officials fear that kind of bounty cannot continue. State policy planners sought an objective voice of reason to diagnose the "state of health" and future potential of such a valuable resource. For a diagnosis and prognosis, they turned to the economists in AREC. The news they heard was mixed.

While the port of Ocean City has earned its credentials as a productive fisheries resource, it faces some serious problems in the future.

For one, the port has a hazardous inlet which severely restricts commercial vessel activity. Second, Ocean City is relatively isolated and distant from the predominant wholesale fish market on the East Coast, New York's Fulton Market.

Third, Ocean City could suffer in the short-term future from the cyclical nature of the fishing business. In the next few years, commercial vessels may look for more bountiful harvests of surf clams – Ocean City's premier landing – off the coasts of New Jersey and Virginia. That, in turn, could prompt commercial fishermen in the Ocean City area to turn to other harvestable species, such as mackerel, squid and hake – all of which make up only a small share of the current dockside market.

Finally, compared to other ports in the Northeast, commercial fishermen from Ocean City received relatively low prices for their catches of finfish in the year studied.

That was the bad news.

Ocean City, add the economists, has some major advantages, too. It is centrally located along the Middle-Atlantic coast, and the local demand for seafood products by the summer tourist trade should continue to be strong.

The National Level

How Much for a Clean Environment?

Virtually everyone says they want a clean, healthy environment. But how much is society willing to pay for a clean environment, and at what point will they say: "Stop. The price is too high"?

Those are questions the Federal Environment Protection Agency (EPA) wants answered, particularly since the Federal government requires all its agencies to evaluate the costs and benefits of their regulatory actions.

EPA turned to AREC researchers and offered them a $475,000 grant to develop the theoretical tools to measure what economists call "nonmarket benefits".

Unlike goods and services – with price tags that are traded in the marketplace – recreational areas, clean air and clean water are difficult for economists to assign a price tag to.

AREC researchers plan to demonstrate their methods by isolating a case study area and studying benefits in what they call the "related goods market". For example, one way to get some idea of how much clean water is worth to a segment of the population is by measuring something tangible, such as property values in areas where water quality has changed.

The researchers also plan to determine for the case study area how much the recreational users would be willing to spend for improved environmental quality.

This study begins at a crucial time when Maryland officials are preparing to implement policies governing the cleanup of the Chesapeake Bay.

The central question in the study is not who is responsible for polluting major bodies of water. Rather, the question is, is it worth having stronger environmental controls on agriculture for cleaner water?

For their part of the bargain, EPA will receive a report describing how economists can improve methods of estimating how much environmental quality is worth to society.

The International Level

How Profitable Is American Agriculture?

Just as the Wall Street financier wants to have some way of evaluating his or her investments, American agriculturists need some method of assessing the profitability of farming under a variety of circumstances.

But unlike the Wall Street money mogul, agriculturists have a much more difficult time accurately measuring the rate of return from investment.

That's the assessment of AREC researchers who studied three problem areas in efforts to measure returns on agricultural investment in resources such as land, equipment and capital.

First, the economists noted that there are several ways to measure returns on investment and none is suitable for all purposes.

Second, even when annual rates of return are measured properly, their economic meaning as indicators of how agricultural investment is likely to fare in the future can be deceptive.

Third, the economists noted that current measurement procedures can underestimate net farm income in inflationary times and can overestimate income when prices are falling.

What does all this mean? According to AREC scientists, the second and third problem areas can be dealt with by economists if they are sufficiently careful when using current data. However, the first problem area is going to require investment in time, money and personnel to develop a sufficient information base – a prospect the researchers do not find encouraging.

Without the information base, they caution, measures of the rate of return to agricultural investment will remain on a shaky foundation, and estimates of those returns must be used with caution.

Monetary Policy and U.S. Agriculture

Agricultural prices are plummeting and observers are talking about the lowest farm incomes since the Depression.

With that kind of bleak news, members of the farm sector are becoming more worried about the effects of national and international monetary policies on U.S. agriculture. What is the relationship between the two?

AREC researchers went through a three-step process to find out.

Generally, they say a restrictive monetary policy may adversely affect the competitive position of an export-oriented sector such as agriculture in the United States.

According to their theoretical model of the relationship, tight money, when combined with adjustments for production and storage of farm commodities, implies that agricultural prices will be lower than other sectors of the economy. The model also implies that agricultural income will fall, as will the return on investment in production.

When they took a second step and compared the results of their theoretical model with those of other empirical studies, AREC researchers found that monetary policies can have more than a neutral effect on the agricultural sector in the short run: A restrictive monetary policy can depress agricultural prices and income.

When they went a third step further, they found that their own statistical analysis of the relationship confirmed what they hypothesized in their model – that restrictive open market policies depress the agricultural sector.

Agriculture and the Environment: A Complex, Symbiotic Relationship

What farmers and other environmentalists have always known by instinct is being confirmed scientifically by UMAES researchers in the laboratory and the field: Agriculture and the environment enjoy a unique, symbiotic relationship. In some cases, one is the cause for grief in the other. But in all cases, the two are so interdependent that to try to discuss one without the other is folly.

Few can dispute that modern agricultural practices share some of the blame for contributing to pollution of the environment. Now, researchers are coming to focus more on how the environment – at its pristine best and polluted worst – can wreak havoc with agricultural productivity.

Just how much does one affect the other? How can the two assist each other?

Side One of the Coin:

Agriculture's Footprint On The Environment

The increase in nutrient and toxic substances, and the demonstrated decline of plant and animal resources in the Chesapeake Bay, are areas of major concern to the Federal Environmental Protection Agency (EPA).

What does agriculture contribute to an unsettling imbalance of that delicate ecosystem?

Preliminary information from EPA indicates that a large amount of the nutrients comes from agricultural sources while most of the toxic substances come from industrial sources.

Nutrients

EPA, environmentalists and the agricultural community are concerned about the movement into the Bay of substances such as nitrogen, most commonly found in commercial fertilizers, manure and sludge, and phosphorus, often found in the effluent of sewage treatment plants and some agricultural waste products.

One way that nitrogen finds its way into ecosystems is by runoff from agricultural lands heavily fertilized with the nutrient. Erosion control techniques, such as no-tillage and minimal tillage methods of cultivation, are becoming increasingly popular among Maryland farmers and help to reverse the problem of runoff.

But researchers want to know more about how nitrogen behaves under both the widely accepted no-tillage methods and under the older, moldboard-plow tillage system. So far, the relationship has been a complex and difficult one to establish. A significant difference in level of performance could sway farmers to use a cultivation method that contributes to runoff, erosion and eventual pollution, or to use one that avoids these problems.

In a 4-year, UMAES study, agronomists examined how nitrogen behaves under the two tillage systems.

They found that there was no difference in nitrogen behavior between the two systems at application rates above 120 pounds per acre on corn. At nitrogen rates below 120 pounds per acre, the plow tillage system made better use of both soil-borne and fertilizer nitrogen and plants did a better job of recovering nitrogen fertilizer. Probably this was at least partially due to greater release of nitrogen from the soil under plow tillage. Minimal tillage reduces soil erosion and the chance of nitrogen running off fields. If more nitrogen is lost from minimal-till fields, it is likely that it is due to a process called "denitrification", in which nitrogen fertilizers are converted to a gas, escape the soil and move into the atmosphere.

Although runoff from agricultural lands is generally pointed to as a prime contributor to pollution of the Chesapeake Bay, a 5-year study completed by scientists from the departments of agronomy and agricultural engineering shows evidence to the contrary as well as significant differences between two tillage systems. In their study, researchers examined how much nitrogen and phos phorus escaped from conventional- and no-till lands planted in piedmont soils – the type of soil that makes up the bulk of soil types in the Bay basin.

In general, the scientists discovered that:

- Conventional-tilled lands produced more than nine times as much runoff as no-till lands;

- In 1 year of the study alone, conventional-tilled lands gave up 29 times more soluble solids than no-till lands and nearly 4 times more in sediment losses;

- Nitrogen and phosphorus losses under both tillage systems were very small, but losses under conventional systems were still larger than those under the no-till system. Much of the agricultural land surrounding the Bay basin is planted under no-till systems.

They also concluded from the study that the reason little nitrogen or phosphorus ran off the farm lands they examined was because most rainfall was absorbed rapidly into the soil. Runoff, they added, generally occurs only when significant amounts of rain fall on soils already saturated with water.

Toxic Substances

A 3-year, UMAES study, conducted by scientists with the university's department of agronomy and USDA, suggests that the highly prolific, corn-producing region surrounding the Wye River estuary, a major tributary to the Bay, is not a major contributor to some of the toxic substances in the Chesapeake.

In their study, scientists monitored the movement of the herbicides atrazine and simazine, from the time the chemicals were applied to corn fields to the the time any trace of the chemicals showed up in the Wye River.

They found that the total amount of herbicide reaching the estuary depended upon the quantity applied in the watershed area, and upon the proximity of application date to times of runoff, produced by rainfall.

In 1 year in which there was significant runoff within 2 weeks of the chemical's application, 2 to 3 percent of the atrazine moved into the estuary. In the other 2 years when there was less rainfall, or when runoff occurred long after initial application of the chemicals, even smaller quantities appeared in the estuary.

Over the 3-year, study period, the average concentration of atrazine was less than 3 parts per billion, and the concentration of simazine averaged one-tenth of that figure.

The researchers concluded that, although the area is heavily planted in corn and subject to applications of herbicides, the concentrations of those chemicals in a major tributary to the Bay rarely approach those levels that scientists know will produce minor effects on submerged aquatic vegetation.

Although EPA estimates most toxic substances in the Bay come from industrial sources, toxicologists from the university's department of entomology are monitoring movement of agricultural pesticides to Bay ecosystems. At this point, they are measuring degradation of chemicals in bodies of water and developing research models of that deterioration process to build on the current scientific understanding of how potentially toxic chemicals lose their lethal nature.

Model Building

Keeping tabs on an enormous land area and monitoring what leaves that land to end up in the Chesapeake Bay is a complicated task. Oftentimes, when scientists find themselves facing an unmanageable, highly complex problem, they will take a larger-than-life situation and reduce it to something smaller and manageable – a model of the original problem. Model building in research is nothing more than creating a highly accurate, if abstract, representation of the real thing.

In a 5-year, UMAES study, that is just underway, researchers in agricultural engineering and the university's Center for Environmental and Estuarine Studies (UMCEES) are doing just that – constructing computer models of how, when and why agricultural chemicals move from lands planted in conventional and minimal tillage systems to watersheds that feed into the Chesapeake Bay.

After approximately 1 year of monitoring the quality and amount of surface and subsurface water near the Wye River, the team of scientists expects to develop "budgets" for the two types of agricultural land use. These budgets will serve as a ledger-type comparison of which tillage system contributes varying forms of pollution under a number of environmental conditions.

Their next step? They will execute the actual construction of the model, using the budget information to simulate by computer the movements of chemicals from land to water.

Side Two of the Coin:

How Do Environmental Conditions Affect Agriculture?

This planet's environment has never been the same for any more than a couple of thousand years at a time. In the beginning it was a churning, chaotic soup of gases rendering life as we now know it impossible.

Today, Earth's atmosphere is filled again with a discord of pollutants and elements that, in lesser quantities, would not pose a threat to modern agriculture.

Still, it is our environment and, for better or worse, it is incumbent upon scientists to come to grips with the fact that drought and deluge are not the only vagaries inflicted upon today's farmer by the environment.

That rusting effect and loss of needles a farmer has noticed on a crop of pines could be the result of what scientists call "the chemistry of atmospheric deposition" – an umbrella term that includes acid rain and air pollution.

Most scientists agree that ozone air pollution is in sufficient quantity and severity in some parts of the country to cause damage to agricultural crops. Some scientists, however, believe air pollution has little effect on major grain-growing regions.

University agronomists initiated, as part of their major, 6-year research of air pollution effects on plants, a study of how six wheat cultivars responded to air pollution during flowering.

Their studies confirm that air pollution, particularly during the month of May in the Mid-Atlantic states, can significantly affect wheat yields and grain quality.

Dry plant weights dropped by 13 percent, compared to healthy plants, and yields of plants exposed to pollution were 27 percent lower than healthy, control plants. Even those plants that were able to resist foliar injury from pollution had significantly lower grain yields.

In another study, technicians at the Wye Research and Education Center each Tuesday collect two buckets at the center's newly erected weather station. One bucket contains precipitation collected during the preceding week, the other is a "dry" collector – an indicator of airborne moisture and chemistry. Both are analyzed at the center for moisture and pH – a measure of acidity or alkalinity – then sealed and shipped to a separate lab for comparative analysis.

The results so far: Acid rain, indeed, has come to Maryland. Researchers at the Wye, located in what many consider a pristine environment, say their measurements show several rainfalls in Maryland during 1983 hovered significantly below the pH of 5.6, which is considered normal for rainfall.

In addition to this relatively new problem, Maryland farmers still have to cope with the age-old problem associated with the vagaries of weather and weather reports.

At the Wye, scientists are gathering raw data monitored through the center's weather station to build computer models of long-term weather trends for Maryland's Eastern Shore.

If they are successful, those models should help scientists provide local farmers and vegetable growers with enough advance information about local weather patterns to give them more of an edge in their now high-stakes gamble: Unpredictable weather is the "house", with most of the odds stacked in its favor.

Moreover, charting weather trends with more reliable information than the old-fashioned almanac should provide scientists with one more advantage: Better information can help them do a better job of assessing the results of agricultural field research, work that is so heavily dependent upon the whim of weather.

In a parallel study, entomologists are using raw weather data to explore the relationship between temperature and insect pest outbreaks. That information will prove valuable to the university's Integrated Pest Management program.

Putting It Together:

Can Agriculture and Waste Materials Coexist?

Man produces food, and man produces wastes. Can the two exist side by side?

Consider: Maryland's residents produce 1,400 wet tons of sewage sludge each and every day. In the next 20 years, the state must dredge 155 million cubic yards of material from Baltimore harbor to keep the busy port open to ocean-going vessels. Much of that material contains potentially toxic heavy metals.

Neither material by itself is acceptable for agricultural production. Sludge is basic when stabilized with lime, and it contains large amounts of nutrients such as nitrogen and phosphorus. Dredged spoils are usually highly acidic and carry large doses of heavy metals.

But halfway through a 5-year study, university agronomists are finding that, if you put the two together, you might come up with soil that is acceptable for some agricultural practices. They believe, in fact, that new land can be "built" using combinations of sludge and dredged spoils.

At a study site in Baltimore harbor, they have observed a "natural invasion" of marsh reeds commonly found in recreational and wildlife areas. The scientists also have grown several varieties of turfgrass and vegetables such as radishes, cucumbers, sweet potatoes, corn and soybeans.

Most encouraging, however, is the return of wildlife to an area once forsaken by rabbits, muskrats, shrews, quail, pheasant, ducks and seagulls. The researchers believe the greatest promise for fabricated lands from sludge and dredged materials is the creation of new wildlife habitats and recreational areas near the city.

These are but a few examples of the diversity of research from The University of Maryland Agricultural Experiment Station.

Next year you can expect to read in our annual report more about how UMAES researchers are taking on challenges vital to Maryland citizens and, more basically, to the development of scientific knowledge:

The Chesapeake Bay
How can agriculture do its part to reduce pollution in the world's largest inland protein pool?

Genetic Engineering
In spite of its cachet and the seemingly endless sources of money poured into it, genetic engineering still has not unscrambled the code that sets in motion regeneration of adult, agricultural crop plants.

Pest Management
For 25 years, researchers have been writing the book on integrated pest management (IPM) for agricultural crops, built on a foundation of biological, natural and manmade controls. Now IPM researchers are looking for parallel successes in the urban homeowner's backyard.

We welcome your comments on this report and our research.

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